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The species of the genus *Episema* Ochsenheimer, 1816 from Israel: Distribution, Phenology and Ecology; with taxonomical notes and the description of two new species (Lepidoptera: Noctuidae)

M. Fibiger, V. D. Kravchenko, J. Mooser, C. Li & G. C. Muller

Abstract

Sixteen species of *Episema* are known worldwide. Of these, four were recognized as Israeli species however, their taxonomic designations were problematic and confusing. It was these taxonomic issues, together with collection of specimens from the field, which lead to the erection of two new species: *Episema tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n. and *Episema ulriki* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n. Herein, the taxonomical issues of the Israeli species, current and new, are discussed. As well, the characteristics, distribution, phenology, ecology, abundance and association with the main phyto-geographical zones are described.
KEY WORDS: Lepidoptera, Noctuidae, *Episema*, new species, Israel

Las especies del género *Episema* Ochsenheimer, 1816 de Israel: Distribución, Fenología y Ecología; con notas taxonómicas y descripción de dos nuevas especies (Lepidoptera: Noctuidae)

Resumen

Diecisiete especies de *Episema* se conocen en el mundo. De éstas, cuatro eran conocidas como especies israelitas, sin embargo, sus designaciones taxonómicas eran problemáticas y confusas. Fueron estas publicaciones taxonómicas, junto con la colección de ejemplares en el campo, lo que nos ha permitido la erección de dos nuevas especies: *Episema tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n. y *Episema ulriki* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n. Se adjuntan las descripciones de las especies israelitas, tanto de las conocidas como de las nuevas. También se describen las características, la distribución, la fenología, la ecología, la abundancia y la asociación con las zonas fitogeográficas.
PALABRAS CLAVE: Lepidoptera, Noctuidae, *Episema*, nuevas especies, Israel

Introduction

A major collection effort was conducted from 1986-2006 by the Israeli-German project for the study of the Israeli Lepidopteran fauna. This project was a joint effort of The Hebrew University, Tel Aviv University, The Nature Reserves and Park Authority of Israel, the Zoologische Staatssammlung Munich in Germany and Museum Witt in Munich, Germany. Lepidoptera were collected during a period of 18 years, collection taking place on 3000 nights using mobile light traps powered by generator (250 Watt bulbs HQL & ML) and 1500 nights using mobile light trap systems powered by batteries (12 Volt 8 Watt & 20 Watt, 6 Volt 4 Watt Black light UVB tubes) moved on a daily basis. Additionally, a

widespread network of permanent light traps (220 V 20 W Black light UVB & UVC tubes) was maintained. Each year, 10 to 34 traps were in operation and were relocated on an annual basis. Subsequent examination of the large series of Israeli *Episema* Ochsenheimer, 1816 collected revealed more species than previously known. To incorporate these data, a review of the four currently known Israeli species was necessary and two new species were erected.

Taxonomic Notes on the Israeli species of the genus *Episema* Ochsenheimer, 1816

Episema Ochsenheimer, 1816

Schmett. Eur., **4**: 65. Type species: *Bombyx glaucina* Esper, [1789]. L. T.: Germany, Frankfurt am Main.

The genus *Episema* comprises exclusively Old World species that are mainly distributed in central and southern temperate regions of the western Palaearctic, the subtropical areas of the Mediterranean Basin and the Middle East. Sixteen species are known worldwide and four of these are known to occur in Israel. The species not occurring in Israel are listed by RONKAY *et al.* (2001) along with a description of the known early stages and a summary of the bionomics.

The taxonomic status of the four currently recognized Israeli species proved to be rather confusing. The species designation *rubellina* Staudinger, 1892 was suppressed by HACKER (2001) because it was an aberration of *E. lederi* Christoph, 1885. This form (*rubellina / lederi*), from Jerusalem, was attributed by HACKER (2001) to *E. didymogramma* (Boursin, 1955). The holotype of *E. didymogramma* is illustrated by HACKER (2001: pl. 12, fig. 9). However, we found during our studies *E. didymogramma*, which is described from southern Turkey, does not occur in Jordan and Israel, so the afore mentioned aberration *rubellina* belongs either to *E. lemoniopsis* Hacker, 2001 or to the new species described here, *E. tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n. It is very unlikely that *rubellina* belongs to *E. ulriki* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n. because the forewings are a characteristic grey ground colour in all forms. As well, the species *E. lederi* is stated to occur in Israel and Jordan (HACKER, 2001), but our examinations have shown that this is in fact not the case.

Another species designation *discors* Staudinger, 1892 was originally described with type localities from Turkey, Amasia and Jerusalem, Jordan / Israel. HACKER (2001) attributed the lectotype of *discors*, from Amasia, as a synonym to *E. didymogramma* to preserve this better known name (see text to the colour plate 12, fig. 10). If this was correct, the older name *discors* would have priority over *E. didymogramma*, however, Hacker's attribution cannot be stated firmly until the lectotype of *discors* has been checked carefully and compared with the types of both *E. didymogramma*, *E. amasina* Hampson, 1906, also described from southern Turkey and Amasia, and *E. lederi*, described from Armenia (Helenendorf) in 1885 by Christoph. Interestingly, the paralectotype of *E. discors* from Jerusalem, which has no taxonomic value in this case, belongs to another un-described species: *Episema ulriki* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n. (see below). This specimen from Jerusalem is illustrated by HACKER (2001) on plate 12, fig. 10. The following list describes the currently known Israeli species of *Episema* as well as the two newly erected species.

Episema korsakovi levantina Hacker, 2001 (Fig. 1)

The nominotypic subspecies is described from Armenia, Helenendorf. The subspecies from the Levante is described by HACKER (2001: 193), from "Palästina" Jordan / Israel, the imago and the male genitalia are illustrated. Here 1 male was studied: Israel: Hermon Mt., 2000 m, 1-15-X-2003, genit. prep. 5281 M. Fibiger, leg. V. Kravchenko.

Episema lemoniopsis Hacker, 2001 (Figs. 2-3, 13-15)

Esperiana, **8**: 195. L. T.: Lebanon, 30 km E Beirut, 1500 m.

This taxon was already distinguished and named by Boursin. Specimens in the ZSM and LSNK Karlsruhe were type-labelled but never described and published. The male genitalia (aedeagus with everted vesica) of this species were also illustrated by HACKER (2001). The male genitalia (from Israel:

Mt. Hermon, 2000 m, 1-15-X-2003, genit. prep. 5263 M. Fibiger, leg. V. Kravchenko) are re-described under the name *E. tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n., where they are compared with the other regionally distributed species. The female genitalia (from Israel: Hermon Mt., 2000 m, 10-20-X-2003, genit. prep. 5267 M. Fibiger, leg. V. Kravchenko) are also described under *E. tarmardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n. and are illustrated herein.

***Episema tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n.** (Figs. 4-11, 16-18)

Holotype ♂, ISRAEL: See of Galilee area. Amnun. X-2003. V. Kravchenko & G. Müller. coll. Tel Aviv University.

Paratypes: 63 ♂ ♂ and 28 ♀ ♀. 19 ♂ ♂, 1 ♀, Israel: Jordan Valley, Berosh, XII-2004 and XI-2002, 1 ♂, genit. prep. 5274 M. Fibiger, leg. V. Kravchenko. 1 ♂, 1 ♀, Israel: Upper Galilee, -XI-2004, leg. V. Kravchenko. 3 ♂ ♂, Israel: Carmel, Nahal Oren, 2-XI-2000, 1 ♂, genit. prep. 5551 M. Fibiger, leg V. Kravchenko. 1 ♀, Israel: Northern Negev, Tel Arad, X-2004, leg. V. Kravchenko. 1 ♂, 1 ♀, Israel: Judean Desert, Harodian National Park, X-2003, 1 ♀, genit. prep. 5264 M. Fibiger, leg. V. Kravchenko. 1 ♂, 1 ♀, Israel: Jordan Valley, Amnun, near Kineret, XI-2002 and X-2003, 1 ♂, genit. prep. 5265 M. Fibiger, leg. V. Kravchenko. 1 ♀, Israel: Golan Heights, Majdal Shams, X-2002, ♀, genit. prep. 5266 M. Fibiger, leg. V. Kravchenko. 40 ♂ ♂, 22 ♀ ♀, Israel, Amnun north of the Sea of Galilee, from 50 m b. s. l. to 50 m a. s. l., from X to XI-2000, leg. G. C. Muller. Colls. Tel Aviv University, M. Fibiger, G. Ronkay, J. Mooser and ZSM, Munich.

Further: The two males from Jerusalem, from [18]91 and 1892, respectively, illustrated by HACKER (2001), pl. 12, figs 8 (determined as *E. tersa* ([D. & Schiff.], 1775) and 11 (which is the lectotype of the form *rubellina* Staudinger, 1892 of *E. didymogramma* (Bour., 1955)) belong both to *E. tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n.

Description and differential diagnosis

Wingspan: Male 26-31; female 29B34 mm. Antennae of male heavily bipectinate; those of female filiform. Labial palps porrect, third joint downwards bent, twice as long as the second segment, and heavily tufted ventrally. Head smoothly rounded, semi-globular, with rough surface. Scales of head, thorax and forewing ground colour, and fringes concoloured, but extremely variable from light beige, or light greyish, or light brownish, or greyish brown, or grey, or light grey with blackish median area, to reddish brown. Some specimens with totally absent forewing pattern; some with all cross-lines, single and smooth (the lines of *E. ulriki* is waved between the veins); some with orbicular and reniform stigmata prominently marked; all with absent claviform stigma; some with blackish interstigmatal patches; and some where only the interstigmatal patches are weakly marked. Hindwing whitish, or light greyish - darked coloured towards termen, or dark greyish with lighter fringes. Underside unicoloures from white to light grey.

The male genitalia: Uncus short, stout, bent, apically spatulate and 1,5 x broader than medially (that of *E. amasina* is 2 x broader apically; whereas the width of *E. lemoniopsis* and *E. didymogramma* are 1,2 x wider; and that of *E. lederi* is of the same width throughout). Tegumen broad, shorter than vinculum. Saccus short, broad, v-shaped. Valve short, broadest subbasally; cucullus smoothly tapered from the cross-positioned clasper to the tip (the cucullus of *E. amasina* is broader and shorter; that of *E. lemoniopsis* is narrower; that of *E. didymogramma* is shorter and narrower; and that of *E. lederi* is shorter, but with the same width). Clavus is narrow, angelled 60 degree at tip (narrower, broader angelled than in any of the other species compared here). Ampulla short, broad (similar to those of the others, except that of *E. lemoniopsis*, which is longer). Juxta with a dorsal cleft, ovoid, 1,5 x higher than wide (similar to those of the others, except those of *E. lemoniopsis* and *E. didymogramma*). Aedeagus short, bent, with a carina-spine on the much longer right side. Basal cornutus on the left dorso-lateral side (smaller than that of *E. amasina* and *E. lemoniopsis* (which has the largest); slightly shorter than that of *E. lederi*; and much larger than that of *E. didymogramma*). Vesica medially with a membranous, narrow,

ventrally bent diverticulum (this diverticulum is absent in *E. amasina* and *E. lemoniopsis*; and smaller, broad, and straight in *E. didymogramma* and *E. lederi*). Apically on vesica it is armed with two parallel, narrow, elongate spine-bands, comprised by a cluster of small, narrow spines; the left one shorter and longer than the right band (in *E. amasina* the bands are close to equally long; those of *E. lemoniopsis* are slightly broader and similar in length with *E. tamardayanae*, but the left band is the longer; in *E. didymogramma* the bands are slightly uneven in length, with the left band as the shortest, but both bands are much smaller than those of *E. tamardayanae*; in *E. lederi* the bands are very narrow and long; the right one slightly longer than the left band).

The female genitalia: Ovipositor quadrangular, concave mid-apically, clothed with narrow, hair-like setae. Both apophysis equally long, approx. of the same length as the 8th abdominal segment; the posterior starting from a small plate. Postvaginal plate membranous. Antevaginal plate prominently sclerotised, folded, laterally with a raised, arch-like top. Ostium membranous. Ductus bursae dorsally membranous, heavily sclerotised ventrally (the sclerotisation is shorter in *E. leminoopsis*). Basal third part of corpus bursae scobinate and enlarged; distal part cylindric and membranous (in *E. lemoniopsis* the basal part is also scobinate, but with a heavily sclerotised semi-globular plate ventrally).

Etymology

The new species is named in honour of Prof. Dr. Tamar Dayan, Director, National Collections of Natural History at Tel Aviv University.

***Episema ulriki* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n.** (Figs. 12, 19-21)

Holotype ♂, ISRAEL: Central Coastal Plain, Yavne. X-1953. J. Halperin, coll. Tel Aviv University.

Paratypes: 3 ♂ ♂, 2 ♀ ♀. 1 ♂, Israel: Jerusalem, [18]92, leg. Paulus; white label: *ledereri* var. *discors*; red label: Origin; coll. NHMU (illustrated by HACKER, 2002: pl. 12, fig. 10.) 1 ♀, Israel: Kineret area, Degania, 14-XI-1952, leg. Y. Palmoni, genit. prep. 5186 M. Fibiger. 1 ♀. 2 ♂ ♂ Israel Nes Ciyyona X-953. J. Halperin.

Description and differential diagnosis

Wingspan: Male 32 mm; female 34B36 mm. Antennae of male heavily bipectinate; those of female filiform. Labial palps porrect, third joint downwards bent, twice as long as the second segment, and heavily tufted ventrally. Head smoothly rounded, semi-globular, with rough surface. Scales of head, thorax and forewing ground colour greyish, with greyish and blackish median area and fringes. Wing pattern well marked: with all cross-lines, single and with arches between the veins (the antemedian and postmedian lines of *E. tamardayanae* are smooth). Orbicular and reniform stigmata prominently marked, white outlined. Claviform stigma absent. Interstimatal patches blackish brown. Hindwing and fringes light greyish, darked coloured before termen. Underside unicoloures light grey.

The male genitalia: Uncus short, stout, bent, apically spatulate equally wide throughout (similar to that of *E. lederi*). Tegumen broad, shorter than vinculum. Saccus short, broad, v-shaped. Valve short, broadest subbasally; cucullus smoothly tapered from the cross-positioned clasper to the tip (the cucullus of that of *E. lederi* is slightly shorter and broader). Clavus is broad, angelled slightly less than a right angel (but still narrower than that of *E. lederi*, which exceed a right angel). Ampulla short, broad (that of *E. lederi* is shorter). Juxta with a dorsal cleft, narrow ovoid, almost 2 x higher than wide (that of *E. lederi* is much larger, broader and longer). Aedeagus short, bent, with a carina-spine on the much longer right side. Basal cornutus on the left dorso-lateral side (similar in size to that of *E. lederi*). Vesica medially with a membranous, narrow, straight diverticulum (this diverticulum is similar but slightly broader in *E. lederi*). Apically on vesica it is armed with two rather short, parallel, narrow, elongate spine-bands, comprised by a cluster of small, narrow spines; the left one is only slightly shorter than the right band (that of *E. lederi* is much longer, but the proportion between the bands is the same).

The female genitalia: Ovipositor quadrangular, concave mid-apically, clothed with narrow, hair-like setae. Both apophysis equally long, a little longer than length of the 8th abdominal segment; the posterior starting from a small plate. Postvaginal plate membranous. Antevaginal plate prominently sclerotised, folded, laterally with a raised, arch-like top. Ostium membranous. Ductus bursae dorsally membranous, heavily sclerotised only on the lateral right side (the sclerotisation in *E. lederi* is prominent throughout ventrally, longer than that of *E. tamardayanae* and *E. leminoopsis*). Basal fourth part of corpus bursae scobinate and enlarged, with a heavily sclerotised cross-positioned ovoid plate ventrally; the distal : part is cylindric and membranous (in *E. lederi* and *E. lemoniopsis* the basal part is also scobinate, but with a heavily sclerotised semi-globular plate ventrally).

Etymology

This is species is named after Ulrik Fibiger, the eldest son of the first author.

Distribution, ecology, and phenology of the Israeli *Episema* species

The species of the genus *Episema* are generally xerophilous, inhabit mostly non-arboreal or only lightly wooded biotopes. Most of the species are found in xerothermic steppes, rocky and sandy grasslands and slopes, appearing as well in lowland as montane semi-deserts, sometimes even in arid deserts. Univoltine autumnal species, the moths do not feed. The caterpillars are generally endophagous, feeding in bulbs of different Liliaceae species, although the mature larvae may also feed on other parts of the plants. The females lay eggs on various plants or on the soil surface and the freshly emerged caterpillars have to search for the host-plant. The larvae pupate in the soil in a strong cocoon (RONKAY, YELA & HREBLAY, 2001). The following list contains a more detailed description of the distribution, ecology, and phenology of the Israeli *Episema* species.

Episema korsakovi levantina Hacker, 2001

Type Locality: Caucasus (no type locality mentioned).

General distribution pattern: Mediterranean-Central Asian. The Balkans, Ukraine, Southern Russia, Transcaucasia, Kazakhstan, Turkmenistan, Turkey and the Levant, so far only recorded from Israel and Syria.

Distribution and occurrence in Israel: Occurs in the Temperate region, in the past, around Jerusalem but not seen since the 1890th, now only on Mt. Hermon above 1800 m. a. s. l., in the Semi-arid region in the Central Negev Highlands above 800 m rare and very local.

Habitat: In Israel this is a montane steppe species. Found on Mt. Hermon above 1800 m., mainly in the sub-alpine tragacanthic steppe with few or no cushion-plants and impoverished montane steppes dominated by Gramineae on xerotherm karstic slopes. Also found in the Central Negev Highlands, above 800 m, in rocky terrain with shrub-steppes and scattered trees of *Pistacia atalantica* in plant communities dominated by *Artemisia sieberi* and *Helianthemum vesicarium* with numerous geophytes. In the past, this species was probably found in the higher steppes east of Jerusalem. In Europe, *E. korsakovi levantina* can be found in xerotherm steppes and semi-deserts, rocky grasslands and plateaus on sandy and calcareous substrate.

Phenology: In Israel univoltine, autumn species, flying from September to November.

Host plants: In Israel unknown; in Europe the young larvae feed in autumn on Gramineae, after hibernation in spring on Liliaceae and in their bulbs.

Episema lemoniopsis Hacker, 2001

Type Locality: Lebanon (Beirut).

General distribution pattern: Endemic of the Levant, so far only recorded from Israel and Lebanon.

Distribution and occurrence in Israel: in the Temperate region, on Mt. Hermon above 1800 m. a. s. l., rare and very local.

Habitat: In Israel a tragacanth species, above 1800 m., mainly in the sub-alpine tragacanthic steppe with numerous cushion-plants such as *Astragalus cruentiflorus*, *Onobrychis cornuta* with *Acantholimon libanoticum*, *A. echinus* numerous Geophytes, annuals and soft herbs as companions on xerotherm karstic slopes.

Phenology: In Israel univoltine, autumn species, flying from September to November.

Host plants: In Israel and elsewhere unknown.

***Episema tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n.** (Figs. 12, 19-21)

Type Locality: Israel, Sea of Galilee area, Amnun village.

General distribution pattern: Presently only known from Israel but possibly further distributed in the Levant and the Irano-Turanian region.

Distribution and occurrence in Israel: wide spread in the Temperate and Semi-arid regions. Fairly common in the northern part of the Rift Valley especially in the area of the Sea of Galilee and the Hula Valley elsewhere rare.

Habitat: In Israel a grassland species, in all kinds of open and forested grasslands, in open Park Forests, along the fringes and in larger clearings of forests, wasteland, to a smaller extent also in gardens and parkland, in the Semi-arid region in semi-steppe Bathas in rich herbaceous plant communities and in shrub-steppes with annual rainfall above 250 mm., especially in deep shady canyons, on xerotherm slopes mainly in areas with hard rock outcrops.

Phenology: In Israel univoltine, autumn species, flying from October to December.

Host plants: In Israel larvae were found endophagous in bulbs of *Allium neapolitanum* (Liliaceae); elsewhere unknown.

Remarks: In the past confused with the wide spread sister species *Episema tersa* ([D. & Schiff.], 1775). *E. tersa* is known from south-eastern Europe to Turkey, the Levant and Iran to Central Asia and Western China. It is presently not clear if or how far the new species is spread in this area.

***Episema ulriki* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n.** (Figs. 4-11, 16-18)

Type Locality: Israel, Sea of Galilee area, Kibbutz Degania.

General distribution pattern: Indigenous to the Levant, so far only recorded from Israel.

Distribution and Occurrence in Israel: Found in the temperate region in the northern Rift Valley and along the Coastal Plain. This species was not seen since the 1950's.

Habitat: In Israel this is a wetland species, found in the area of the Sea of Galilee on wet and seasonally flooded grassland, as well as along the banks of the River Jordan, along the Coastal Plain in the former wetlands and swamps from Quesaria to Rehovot (pers. com. J. Halperim and Y. Palmoni).

Phenology: in Israel this species is probably a univoltine, autumn species, flying from October to December.

Host plants: In Israel host plants are unknown, but possibly like other congeners on Gramineae and Liliaceae.

Remarks: A few specimens of this species were collected by J. Halperin and Y. Palmoni 1951 and 1954.

Discussion

Under the auspices of the Israeli-German project for the study of Israeli Lepidopteran fauna, a major collection effort was conducted from 1986-2006. A large series of Israeli *Episema* species was collected which, upon examination, revealed more species than previously known. To incorporate these data, we have reviewed the four currently known Israeli species, including the two new Israeli *Episema* species.

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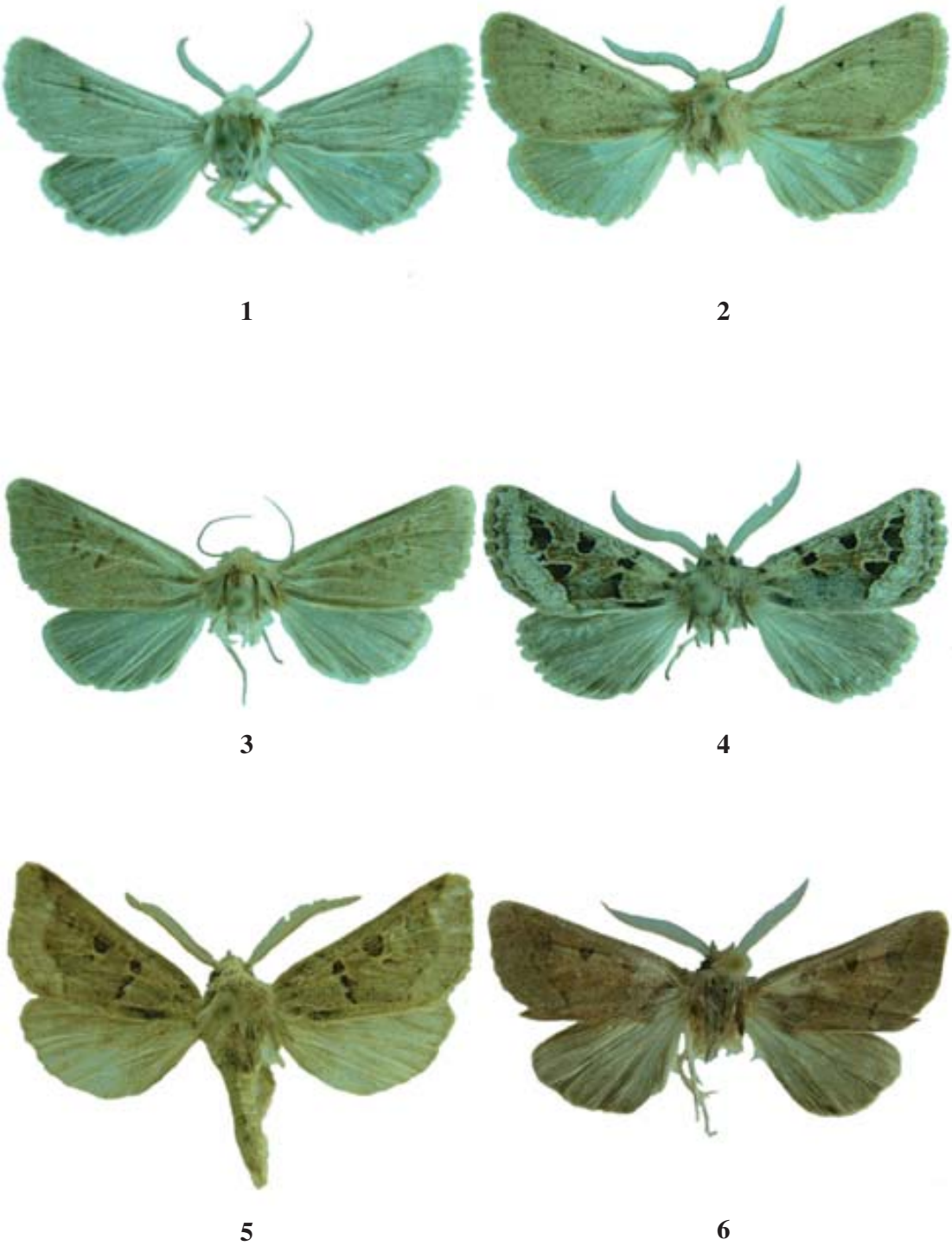

Figs. 1-6.– 1. *Episema korsakovi* (Christoph, 1885). **2-3.** *Episema lemoniopsis* Hacker, 2001. **4-6.** *Episema tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n.

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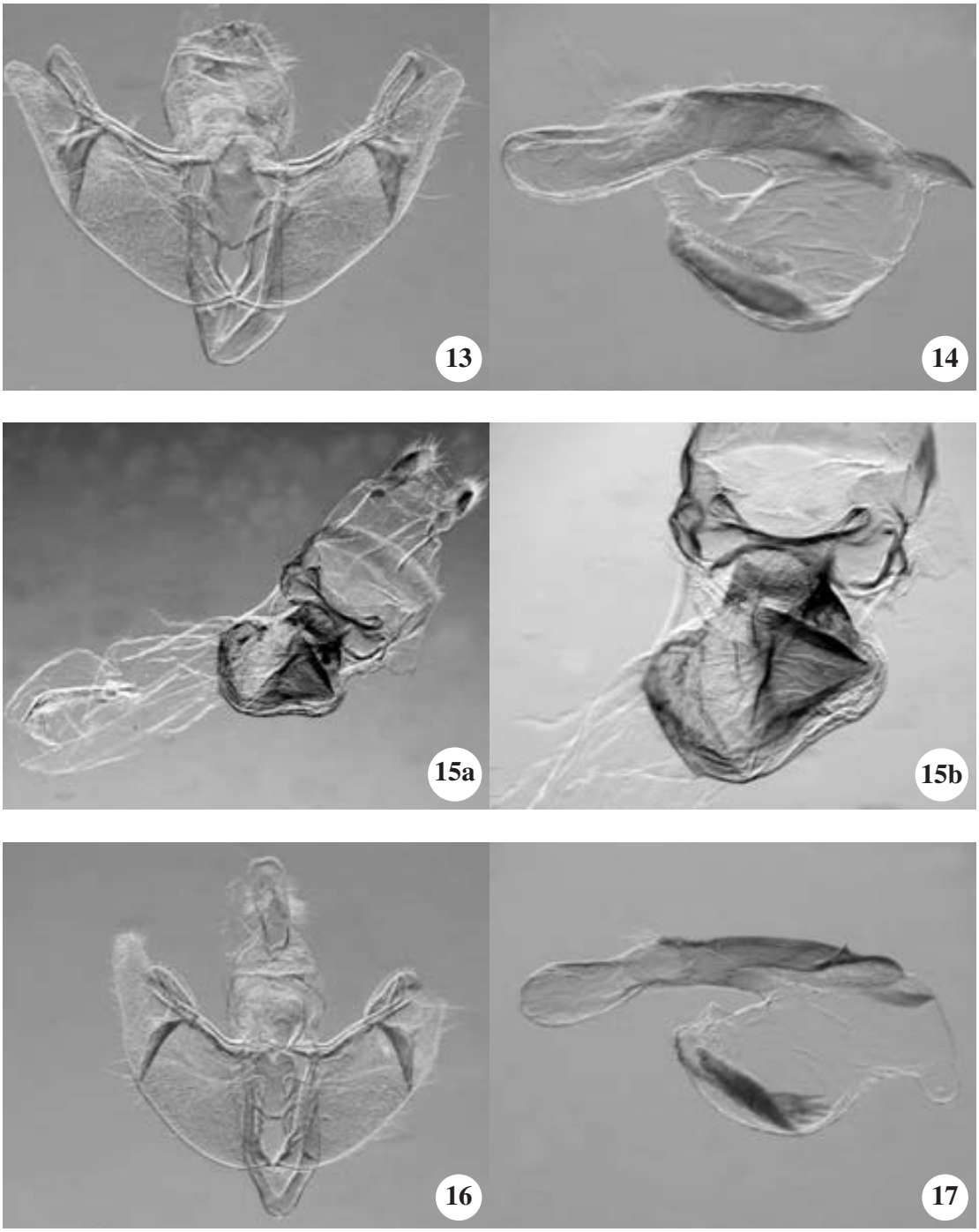
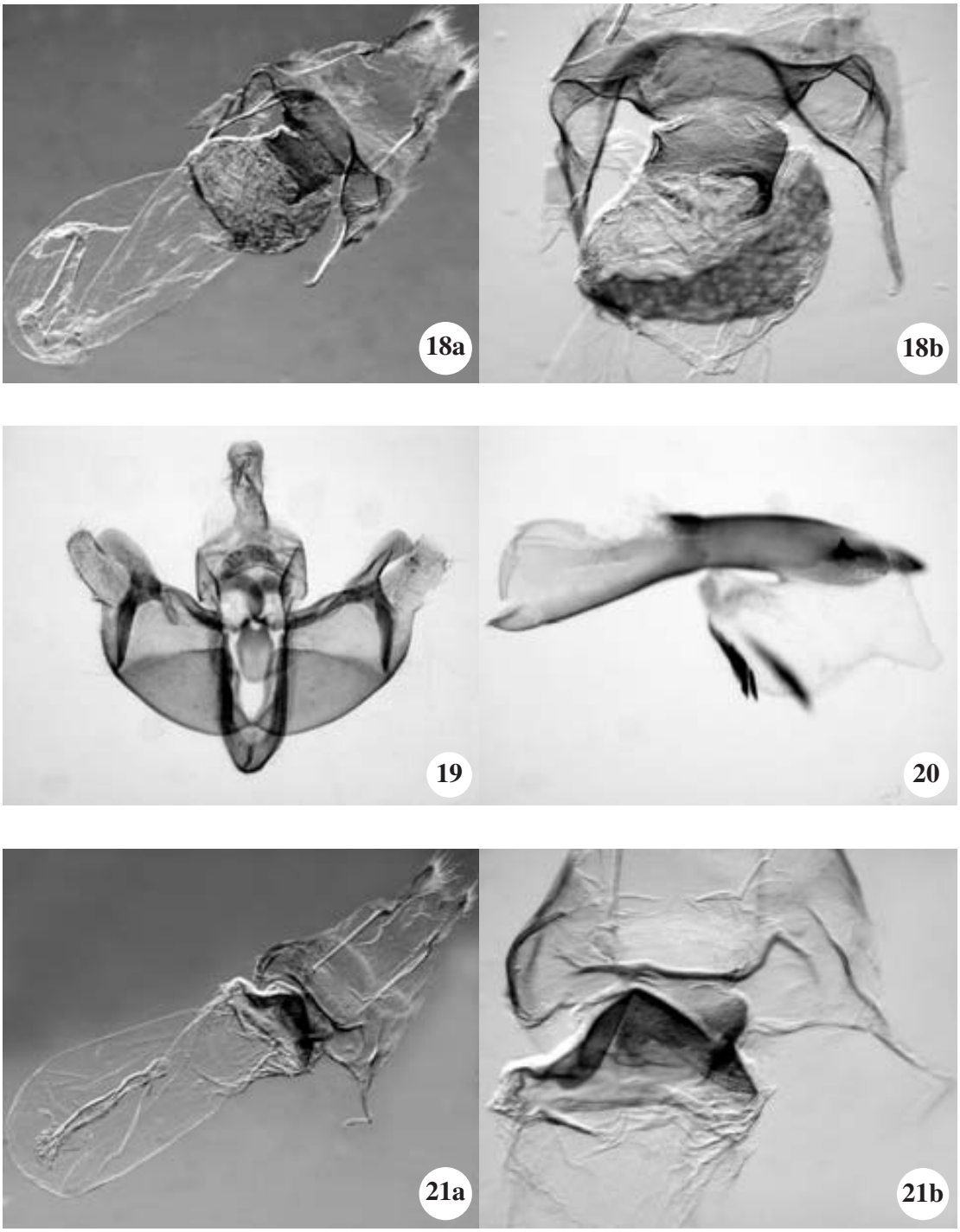
Figs. 7-12.– 7-11. *Episema tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n. **12.** *Episema ulriki* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n.



Figs. 13-17.– 13. Male genital armature of *Episema lemoniopsis* Hacker, 2001, genit. prep. 5263 M. Fibiger. **14.** Aedeagus with everted vesica of *Episema lemoniopsis* Hacker, 2001, genit. prep. 5263 M. Fibiger. **15a-b.** Female genitalia of *Episema lemoniopsis* Hacker, 2001, genit. prep. 5267 M. Fibiger. **16.** Male genital armature of *Episema tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n., genit. prep. 5274 M. Fibiger. **17.** Aedeagus with everted vesica of *Episema tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n., genit. prep. 5274 M. Fibiger.



Figs. 18a-21b.– 18a-b. Female genitalia of *Episema tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n., genit. prep. 5266 M. Fibiger. **19.** Male genital armature of *Episema ulriki* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n., genit. prep. 5550 M. Fibiger. **20.** Aedeagus with everted vesica of *Episema ulriki* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n., genit. prep. 5550 M. Fibiger. **21a-b.** Female genitalia of *Episema ulriki* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n., genit. prep. 5186 M. Fibiger

Figs. 22-23.– 22. Coastal seasonal wetlands. Biotope of *Episema ulriki* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n. **23.** Grassland slopes of the Golan Heights near Amnun settlement north of the Sea of Galilee. Biotope of *Episema tamardayanae* Fibiger, Kravchenko, Mooser, Li & Muller, sp. n.